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New anuran records for Tabasco, Mexico

Liliana Ríos-Rodas[1], Claudia Elena Zenteno-Ruiz[1], María del Rosario Barragán-Vázquez[1], Luis Canseco-Márquez[2], Marco Antonio López-Luna[1]

1 División Académica de Ciencias Biológicas, Universidad Juárez Autónoma de Tabasco, Carretera Villahermosa-Cárdenas km 0.5 S/N, entronque a Bosques de Saloya. Villahermosa, Tabasco, Mexico. C.P. 86150. **2**Departamento de Biología Evolutiva, Laboratorio de Herpetología, Facultad de Ciencias, UNAM, AP 70-399, Mexico, D.F. 04510.
Corresponding author: Claudia Elena Zenteno-Ruíz, cezenteno@yahoo.com.

Abstract
We report the first records of five species of hylid frogs from the Mexican state of Tabasco: *Charadrahyla chaneque* (Duellman, 1961), *Duellmanohyla chamulae* (Duellman, 1961), *Exerodonta bivocata* (Duellman & Hoyt, 1961), *Quilticohyla zoque* (Canseco-Márquez et al. 2017), and *Ptychohyla macrotympanum* (Tanner, 1957). These species are associated with streams in tropical evergreen forests and were previously thought to be restricted to one or more of the nearby Mexican states of Chiapas, Oaxaca, and Veracruz.

Keywords
Huimanguillo, evergreen forest, stream, frogs, hylids.

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Introduction

The state of Tabasco lies near or adjacent to Oaxaca, Veracruz, and Chiapas, three of the most species-rich states in Mexico for amphibians. However, the amphibian fauna of Tabasco remains comparatively poorly known and understudied. By 2014, only 23 species were documented for the state (Parra-Olea et al. 2014), and targeted field surveys in the intervening five years has increased the number to 31 (Barragán-Vázquez 2019). These records are in southern Tabasco, belonging in the province of the Sierra Madre de Chiapas and Guatemala.

The anuran family Hylidae is among the most widely distributed and species-rich groups of New World frogs, and their greatest diversity is found in the tropics. These species are generally nocturnal, have adapted to a wide array of ecological niches, and are arboreal, fossorial, or even semi-aquatic (Lee 1996; Santiago-Pérez et al. 2012). Many of hylid species regularly inhabit vegetation adjacent to low-velocity or stagnant streams, where they feed and reproduce (Altamirano-Álvarez et al. 2016). Hylid frogs are morphologically characterized by widenings at the tips of the fingers and toes which function as adhesive discs and allow frogs to climb and hold onto smooth surfaces. Other characteristics of the family include moderately long limbs and membranes between the digits which allow them to swim efficiently (Lee 1996; Santiago-Pérez et al. 2012).

Tabasco is known currently to support 12 species of hylids: *Agalychnis callidryas* (Cope 1862a), *Dendropsophus ebraccatus* (Cope, 1874), *D. microcephalus* (Cope, 1886), *Ecnomiohyla miotympanum* (Cope, 1863), *Trachycephalus typhonius* (Linneaeus, 1758), *Scinax staufferi* (Cope, 1865), *Smilisca baudinii, S. cyanosticta* (Smith,

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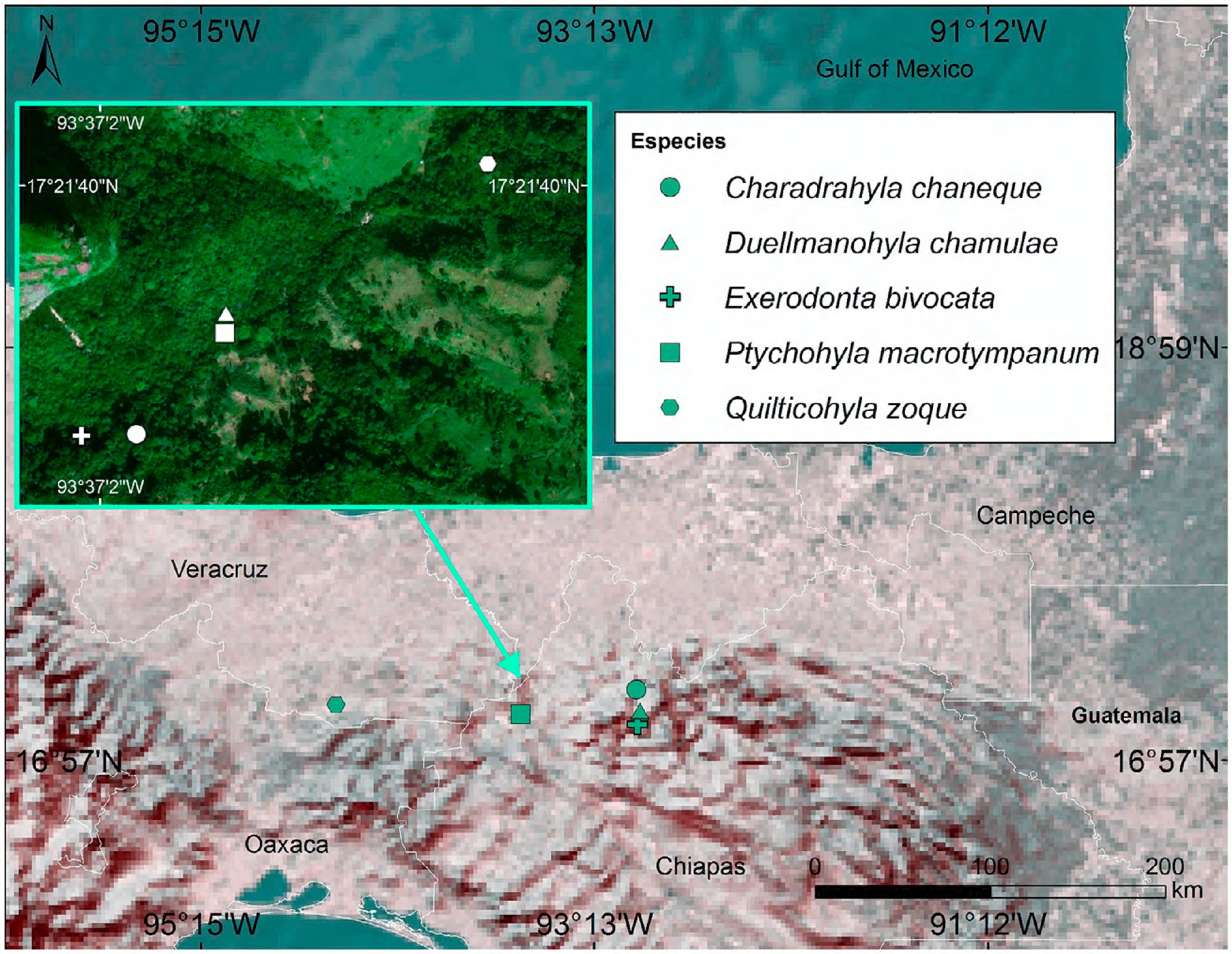

Figure 1. New distribution records of hylids in Tabasco state, Mexico. The white points represent new records from the state of Tabasco and the green points indicate the nearest historical records.

1953), *Tlalocohyla loquax* (Gaige & Stuart 1934), *T. picta* (Günther, 1901), *Triprion petasatus* (Cope, 1865), and *T. spinosus* (Steindachner, 1864) (Torres-Pérez and Barragán-Vázquez 2005; Torrez-Pérez and Barragán-Vázquez 2017; Barragán-Vázquez 2019). With the present study we add five new hylid frog species to this list, which increases the number of hylid species documented in the state to 17.

Methods

We carried out field surveys and collection of voucher specimens from September 2017 to August 2018 along a stream surrounded by secondary-growth evergreen tropical forest in a locality known as Villa Guadalupe, Municipio de Huimanguillo, Tabasco (Fig. 1). We documented specimens during both diurnal and nocturnal surveys. Once captured, we identified anurans to species level using the taxonomic keys of Duellman (1970), Köhler (2011), and Canseco-Márquez et al. (2017). We gathered morphological measurements using digital calipers (precision 0.01 mm) and determined sex through male vocalizations and the presence of nuptial excrescences. We recorded geographical coordinates from specimen-collection points using a handheld Garmin 64s unit. To confirm the geographical novelty of the species we report herein, we consulted the following databases: VertNet, GBIF, CNAR, and CONABIO-SNIB. All specimen collections were authorized under federal permit (SGPA/DGVS/0599/19), and the material was deposited in the Colección de Anfibios y Reptiles de Tabasco (CART), División Académica de Ciencias Biológicas, Universidad Juárez Autónoma de Tabasco, Villahermosa, Tabasco, Mexico.

Results

The five new records of hylids in Tabasco in this study are listed and described as follows:

Charadrahyla chaneque (Duellman, 1961)

New record. MEXICO: Tabasco, Huimanguillo, Villa de Guadalupe (17°21′28.68″N, 093°37′00.27″W; 530 m elevation), collected by Liliana Ríos-Rodas, 17 June 2018; a single metamorphic specimen (CART 01055) at 15:00 h perched on a trunk at the edge of a stream (Fig. 2A).

Identification. The metamorphic specimen was identified by its brown dorsum with darker green or brown blotches, a cream-colored venter, transverse bands on the

limbs, a small tympanum, a truncate snout, and a tuberculate dorsum (Duellman 1970). The collected specimen had a mean snout-vent length of 22 mm and a tail length of 10 mm and is equivalent to Gosner (1960) stage 43, in which it is easier to identify the specimen as it loses its larval characteristics and takes on adult structures.

Duellmanohyla chamulae (Duellman, 1961)

New records. Mexico: Tabasco, Huimanguillo, Villa de Guadalupe (17°12′34.18″N, 093°36′55.98″W, 460 m elevation) found by Liliana Ríos-Rodas, 24 November 2017, 1 juvenile individual at 18:00 h perched on a leaf 1.40 m high in a tropical rainforest. Mexico: Tabasco, Huimanguillo, Villa de Guadalupe (17°12′33.16″N, 093°36′52.68″W, 440 m elevation) collected by Jenny C. Estrada-Montiel, 18 March 2018, at 21:10 h (1 adult male specimen, CART 01021). Subsequently, from March to August we observed but did not collect 63 additional individuals, all perched on leaves and rocks near a stream (Fig. 2B).

Identification. The specimens were identified following Duellman (1970), based on their green dorsal color, presence of a narrow white labial stripe that extends along the side of the body, extensive webbing on the hand, and a reddish-bronze iris. Males attain a maximum snout-vent length of 30.5 mm and females reach 31.8 mm. Another distinguishing character in males is the presence the nuptial spines and mental gland, both of which were visible in our collected specimen.

Exerodonta bivocata (Duellman & Hoyt, 1961)

New records. Mexico: Tabasco, Huimanguillo, Villa de Guadalupe (17°21′28.6″N, 093°37′02.88″W; 530 m elevation) found by Liliana Ríos-Rodas, 11 February 2018, perched on leaves (Fig. 2C) at 18:00h (1 adult male, SVL 26 mm). Mexico: Tabasco, Huimanguillo, Villa de Guadalupe (17°21′29.60″N, 093°37′01.02″W; 515 m elevation) collected by José C. Gerónimo-Torres on 11 February 2018, perched on a rock in tropical rainforest at 18:25 h (1 adult male, CART 01024, SVL 25 mm). Mexico Tabasco, Huimanguillo, Villa de Guadalupe (17°21′33.5″N, 093°36′55.66″W; 465 m elevation) collected by José Maria Gutierrez-Suarez, 21 April 2018, perched on leaves near a stream at 21:00 h (2 adult males, CART 01032, 01034). Mexico Tabasco, Huimanguillo, Villa de Guadalupe (17°21′32.7″N, 093°36′55.84″W; 470 m elevation) collected by Liliana Ríos-Rodas, 23 June 2018, perched on leaves and rocks at 21:00 h. (three adult males, CART 01045– 01047) (Fig. 2C).

Identification. The specimens were identified using the taxonomic keys of Duellman and Hoyt (1961) and Duellman (1970) based on the following characteristics: the iris is pale golden-bronze with fine black flecks, tympanum distinct, axillary membrane extending at least midway to elbow, having slightly less webbing, tarsal fold present. The dorsal coloration is generally yellowish

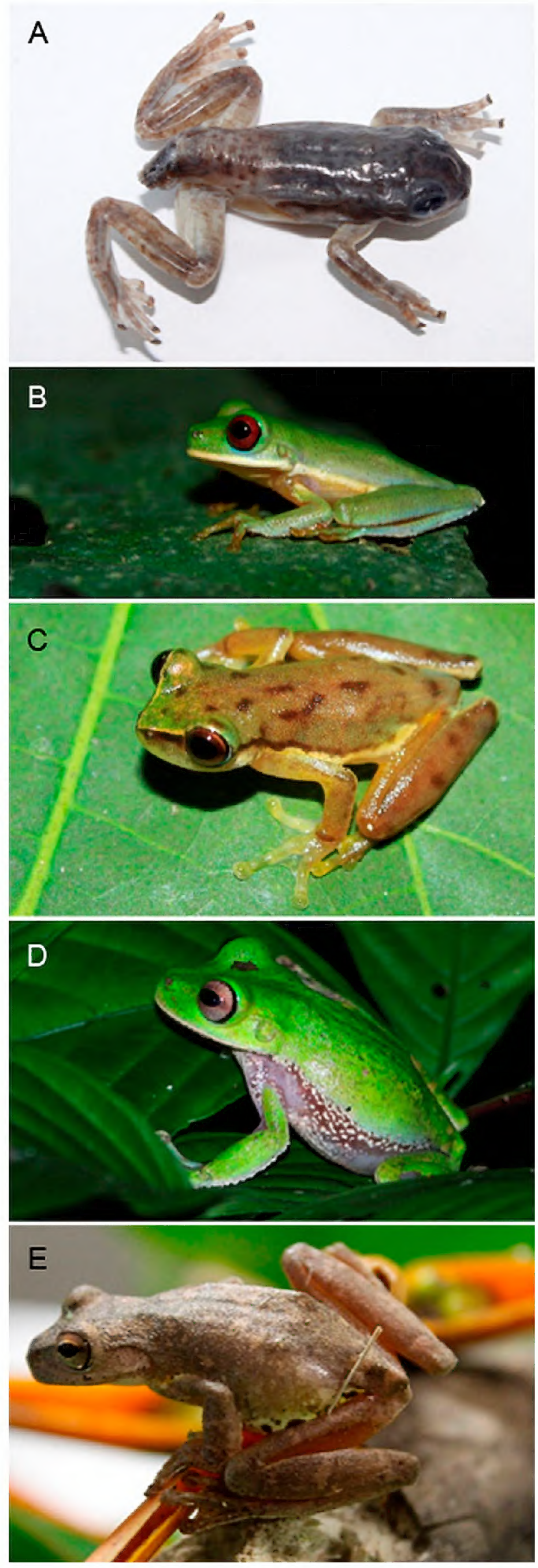

Figure 2. Five newly recorded anurans in Tabasco, Mexico. **A.** *Charadrahyla chaneque*. **B.** *Duellmanohyla chamulae*. **C.** *Exerodonta bivocata*. **D.** *Quilticohyla zoque*. **E.** *Ptychohyla macrotympanum*. Photographs by José del C. Gerónimo-Torres.

tan or pale brown, usually marked with bold dark spots and with a faint white cloacal stripe. The collected specimens had a mean snout-vent length of 27 mm.

Quilticohyla zoque (Canseco-Márquez, Aguilar-López, Luría-Manzano, Pineda-Arredondo & Caviedes-Solis, 2017)

New records. Mexico: Tabasco, Huimanguillo, Villa de Guadalupe (17°21′41.00″N, 093°36′39.12″W; 420 m elevation), found by Jose C. Gerónimo-Torres, 23 September 2017, perched on leaf of secondary vegetation (acahual) 1.40 m high at the edge of stream (Fig 2D). Mexico: Tabasco, Huimanguillo, Villa de Guadalupe (17°21′40.98″ N, 093°36′43.5″W; 400 m elevation), found by Liliana Ríos-Rodas, 10 February 2017, perched on branch at 21:40 h (1 adult female, SVL 49 mm) (Fig. 2D). Subsequently, we observed 42 additional individuals nearby in both primary and secondary vegetation, always near the stream. We collected and preserved eight of these specimens (CART 00992–00994, 00997, 00998, 01015–01017).

Identification. This species was recently described by Canseco-Márquez et al. (2017), with diagnostic features as follows: pale pink iris with brown reticulations, green dorsal coloration with brown blotches and numerous irregular white spots, small nonspinous nuptial excrescences, and lack of the chest gland in breeding males.

Ptychohyla macrotympanum (Tanner, 1957)

New records. Mexico: Tabasco, Huimanguillo, Villa de Guadalupe (17°21′33.30″N, 093°36′56.03″W; 465 m elevation), found by Jenny C. Estrada-Montiel, 25 November 2017, perched on a leaf in the vicinity of a stream (Fig. 2E) at 23:00 h (1 adult female, SVL 39 mm).

Identification. This frog was identified by the presence of a narrow white line extending along the length of the upper lip and a grayish-white line above the cloaca. Additionally, a pale tan dorsum and dark flecks on the venter are present. An additional distinctive feature present in the collected specimen and described in the literature is a dull coppery bronze iris. This species can be distinguished from *P. euthysanota* by the presence of dermal fold, but no row of tubercles and flanks no white lateral stripe (Duellman 1963, 1970, 2001).

Discussion

All five species newly recorded from Tabasco belong to the family Hylidae and are associated with slow-flowing streams in tropical evergreen and cloud forests. All are also generally considered imperiled both nationally and internationally, although *Exerodonta bivocata* is categorized as Data Deficient, since its biology and the current population status are unknown (Santos-Barrera 2004).

Of the five newly documented species, *E. bivocata* was observed in its highest abundance throughout the year (82 individuals), with a peak in observations during May and June (21 and 32, respectively) which coincides with the breeding season. During our surveys we consistently encountered this species perched on streamside vegetation in tropical evergreen forest, which is coherent with information from Santos-Barrera (2004). However, we also observed some individuals perched on rocks within the stream. Most of the specimens we observed were adults ($n = 59$), but we also observed metamorphic individuals perched on rocks and leaves near the stream and larvae in pools on the stream periphery. The finding of *E. bivocata* represents a range extension of approximately 68 km in a straight line northwest from the nearest reported locality in Pueblo Nuevo Solistahuacan, Rayon, Chiapas (Brow 2017) (Fig. 1).

Another species that is associated with the vegetation of mountain streams is *Duellmanohyla chamulae*, which is known from a few locations in Chiapas and was recently recorded for the first time in Oaxaca and Veracruz (Aguilar-López et al. 2010; Canseco-Márquez and Ramírez-González 2015). The specimens of this species were found perched in streamside vegetation, with highest observed abundance in the forest (59 individuals), while in the secondary vegetation only six individuals were recorded. These data agree are in agreement with Aguilar-López et al. (2010) who reported that the habitat of this species is restricted to the high forest. Our records extend this species' range 68 km northeast in a straight line from the closest location in Rayon, Chiapas (Furbush et al. 2017) (Fig.1).

Quilticohyla zoque is a Mexican endemic species recently described by Canseco-Márquez et al. (2017). It is relatively common in tropical evergreen forests and appears to be restricted to sites with intact habitats, since they are apparently sensitive to forest degradation (Canseco-Márquez et al. 2017). According to reports, this frog is usually more abundant in pristine vegetation than *D. chamulae*. However, in our study *Q. zoque* was observed in lower abundance in this type of vegetation and was more abundant in secondary vegetation, indicating that it can tolerate some degree of habitat alteration. The distribution of this species is restricted to two localities in Veracruz (Paso del Moral and Arroyo Zarco) (Fig. 1) and one in Oaxaca (Chalchijapa). Our specimens represent the first record for Tabasco, extending the distribution of *Q. zoque* 105 km northeast in a straight line from the nearest locality (Paso del Moral).

For *Charadrahyla chaneque* and *Ptychohyla macrotympanum* we documented only single individuals, both in evergreen tropical forest. *Charadrahyla chaneque* is a Mexican endemic species which is restricted to streams in montane forests and tropical evergreen forests at 100–1600 m in the states of Oaxaca, Veracruz, and Chiapas (Duellman 1970; Ramírez-Bautista et al. 2002; Muñoz-Alonso and Canseco-Márquez 2004). This species is categorized as Endangered by the IUCN, in part because its range is severely fragmented (Muñoz-Alonso and Canseco-Márquez 2004). Most of the

observations in the CONABIO databases date from the 1960s and 1970s (Ramírez-Bautista and Arizmendi-Arriaga 2002; Reynoso-Rosales and Gonzáles-Hernández 2009, McCain 2017), with the most current record being that reported by Muñoz-Alonso and March (2003). Although the area sampled appears broadly suitable for *C. chaneque*, we encountered only one metamorphic individual. This could indicate a small population or that it is more common at higher altitudes, which we did not survey. Our record of *C. chaneque* represents a range extension of approximately 68 km northwest in a straight line from the nearest reported locality in Rayon, Chiapas (Fig. 1).

Finally, *Ptychohyla macrotympanum*, according to Duellman (1970), is found in pine forests, at elevations of 700–1700 m, although there are also historical records from agroecosystems (coffee and maize) at 30 m elevation (Acevedo and Young 2004; Brown 2017). This species is distributed in Guatemala and Mexico and is recorded only in shallow streams of the Sierra Norte de Chiapas (Duellman 1970; Köhler 2008). In our study, we only recorded this species once over an entire year of sampling, which suggests that it is uncommon in the study area. This frog represents a new record for the state and extends the species' distribution 19.2 km from the closest known locality at Tecpatan, Chiapas (Brown, 2017) (Fig. 1).

Although there are some sporadic records of these frogs found in in secondary vegetation, in recent observations have shown that their distribution is restricted to natural forests. Three of the reported species are in the group of threatened categories, following IUCN criteria, mainly due to habitat destruction (Acevedo and Young 2004; Muñoz-Alonso and Canseco-Márquez 2004; Santos-Barrera 2004; Santos-Barrera and Muñoz-Alonso 2004). In our study area, both agricultural and ecotourism could present threats to these species, so it is important to protect their forest and riparian habitats.

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Authors' Contributions

LRR designed the study, collected the specimens, and wrote the initial draft of the manuscript; CEZR helped develop the manuscript; MRBV preserved the specimens and helped develop the manuscript. LCM & MALL identified specimens and provided and reviewed the literature.

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